FROISSART AND HIS CHRONICLE.

No. IV.

THE BATTLE OF POITIERS.

Froissart's description of the latest and most interesting of those great events which shed so much lustre over the English campaigns in France, the battle of Poitiers, may be safely taken altogether as one of the most picturesque and dramatic descriptions of a battle ever written. This is no doubt in some measure owing to the very interesting character of many of the incidents, although it must be remembered that the very choice of such incidents is a feature which pre-eminently distinguishes Froissart from all the other old chroniclers: but this is not all. Froissart rises with his theme; and he now becomes a kind of distant eye-witness of what he describes. We do not mean that he was positively within view of the scene at Poitiers, but he was probably at no great distance, and was certainly immediately afterward in communication with those who had been distinguished actors in it. Up to the time of this battle, in 1356, Froissart principally derives his information from the chronicles of John le Bel, canon of Liege, whose principal informist is understood to have been John of Hainault; but beyond that period Froissart collects his materials for himself, and is constantly travelling with that express object. We may read him, therefore, with the conviction that whilst he is the most amusing and informing of historians of his class, he is at the same time the most faithful.

From the period of the siege of Calais to that of which we are about to speak, the chief events may be briefly passed over. A truce for six years was agreed to, which was but indifferently kept on either side. Whilst it lasted, offers were made on the part of Edward to renounce all pretensions to the throne of France, if King John would yield the absolute sovereignty of Guienne, Calais, and the other territories which had been held by former English monarchs as fiefs. John consented, but his people were most indignant, and would not ratify the arrangement. So in 1355 the Black Prince set out on an expedition from Bourdeaux with sixty thousand men, only a small part of whom were his countrymen. This cruel and ferocious march offers a strange contrast to the gen-

tleness and delicacy which have stamped their impress upon occasional incidents in the career of the Prince, and in none more so than in one of those connected with the field of Poitiers, of which we shall have to speak. But such were the inconsistencies of chivalry, even in its highest stage of development. The Prince's route lay towards the foot of the Pyrenees, thence northward to Toulouse, where he once more changed his direction in order to seize the rich cities of Carcassonne and Narbonne, from which he returned to Bourdeaux. And through all that fair country, a stranger might have followed his track by the blackened ruins of the towns and villages burnt, and the dismal outcries of their unhappy inhabitants. "When they entered into a town, and found it well replenished of all things, they tarried there a two or three days to refresh them. When they departed, they would destroy all the residue, strike out the heads of the vessels of wine, and burn wheat, barley, and oats, and all other things, to the intent that their enemies should have no aid thereof." Whilst the French, maddened by their disgraces and sufferings, were making the most strenuous efforts to collect an overwhelming force to crush the invader, the Black Prince in the following year commenced a similar expedition, though with a force not exceeding twelve or fourteen thousand men. It was in the full tide of success of this march, that he suddenly found himself encompassed on all sides. So universal a feeling of detestation had penetrated the hearts and minds of the French people, that not a single individual could be found to give him intelligence of the position or number of King John's forces, and but for the wonderful steadiness and courage that have so often, in a military sense, redeemed our military errors, those plundering and ravaging expeditions might have worked a fatal retribution. It was late in the night of Saturday, the 16th of September, that a party of the English, who had been sent forward in advance of the army, "saw the great battle of the king: they saw all the field covered with men-of-arms." After a little skirmish, which "these Englishmen could not forbear," they "returned again to the Prince, and showed him all that they saw and knew; and said that the French host was a great number of people. 'Well,' said the Prince, 'in the name of God let us now study how we shall fight with them at our advantage.' That night the Englishmen lodged in a strong place among hedges, vines, and bushes; and their host was well watched."

On the French side, the king and his four sons, having been houseled, that is to say, having received the communion, drew forth his army into the field. "Then trumpets blew up through the host, and every man mounted on horseback, and went into the field, where they saw the king's banner wave with the wind. There might have been seen great nobles of fair harness [armour], and rich armoury of banners and pennons; for there was all the flower of France: there was none durst abide at home, without he would be shamed for ever." Three knights having been sent to learn the array and power of the English, said on their return, "Sir, we have seen the Englishmen; by estimation they be two thousand men-of-arms, and four thousand archers, and a fifteen hundred of other: howbeit, they be in a strong place; and, as far as we can imagine, they are in one battle: howbeit, they be wisely ordered, and along the way they have fortified strongly the hedges and bushes: one part of their archers are along by the hedges, so that none can go nor ride that way, but must pass by them; and that way must ye go, an ye purpose to fight with them. In this hedge there is but one entry and one issue by likelihood that four horsemen may ride afront. At the end of this hedge whereas no man can go nor ride, there be men-of-arms afoot, and archers afore them, in manner of a hearse,* so that they will not lightly be discomfited." Such was the English position: as to the order of attack which the French ultimately determined upon, it may be best seen in development.

On the Sunday morning a new personage came upon the scene, the Cardinal of Perigord, who had been sent by the pope to endeavour to make peace between the king of France and his enemies. And most earnest was the Cardinal in the performance of his duty. First in great haste he came to King John, and knelt before him, holding up his hands, saying, "'Sir, ye have here all the flower of your realm against a handful of Englishmen, as regards your company; and, Sir, if ye may have them accorded to you without battle, it shall be more profitable and honourable to have them by that manner, rather than to adventure so noble chivalry as ye have here present. Sir, I require you, in the name of God and humility, that I may ride to the Prince, and show him what danger ye have him in.' The king said, 'It pleaseth me well; but return again shortly.' The Cardinal departed, and diligently he rode to the Prince, who was among his men afoot. Then the Cardinal alighted, and came to the Prince, who received him courteously. Then the Cardinal, after his salutation made, said, 'Certainly, fair son, if you and your council advise justly the puissance of the French king, ye will suffer me to treat to make a peace between you, an I may.' The Prince, who was young and lusty, said, 'Sir, the honour of me and my people saved, I would gladly fall to any reasonable way.'" The Cardinal now "rode again to the king, and said, 'Sir, ye need not to make any great haste to fight with your enemies, for they cannot flee from you though they would, they be in such a ground: wherefore, Sir, I require you forbear for this day, till tomorrow the sun rising.' The king was loth to agree thereto, for some of his council would not consent to it; but, finally, the Cardinal showed such reasons, that the king accorded that respite. And in the same place there was put up a pavilion of red silk, fresh and rich, and leave gave for that day every man to draw to his lodgings, except the Constable's and Marshal's battles."

All efforts at reconciliation, however, were vain, although "that Sunday, all the day, the Cardinal travelled in riding from one host to the other, gladly to agree them." Many offers were made on both sides. In the main the French king demanded that four of the principal Englishmen should be placed at his absolute disposal, and the Prince and all other to yield themselves as prisoners. The Prince offered to render all the towns and castles he had won in the present expedition, as well as the prisoners taken, and to swear not to bear arms against the French for seven years. At last King John made his final offer, that the Prince and a hundred of his knights only should yield themselves prisoners, which was absolutely rejected; and the Cardinal in despair returned to Poitiers, in the neighbourhood of which the battle was fought.

All this while our countrymen were making admirable use of the time, strengthening the hedges, and widening and deepening the dykes. At sunrise on Monday morning the indefatigable Cardinal was once more seen passing to and fro between the hosts, thinking, says Froissart, "by his preaching to pacify the parties." Short and abrupt was the answer he received on each side. "Return whither ye will," said the Frenchman impatiently; "bring hither no more words of treaty or peace; and if ye love yourself, depart shortly." Hastening then to the Prince, he said, evidently with deep emotion, "Sir, do what you can—there is no remedy but to abide the battle, for I can

* Or harrow; *i.e.* the men were placed in the order of the mimic combatants of a draught-board.

find none accord in the French king." The Prince simply and cheerfully answered, "The same is our intent and all our people: God help the right." As the Cardinal disappeared, the Prince turned to his men, and thus addressed them: "Now, Sirs, though we be but a small company, as in regard to the puissance of our enemies, let us not be abashed therefore; for the victory lieth not in the multitude of people, but whereas God will send it. If it fortune that the journey be ours, we shall be the most honoured people of all the world; and if we die in our right quarrel, I have the king, my father, and brethren, and also ye have good friends and kinsmen: these shall revenge us. Therefore, Sirs, for God's sake I require you do your devoirs this day; for if God be pleased, and Saint George, this day ye shall see me a good knight." And, continues Froissart, "These words and such other that the Prince spake comforted all his people."

The battle began on all sides as the battalions of the Marshal of France approached, evidently in order to break the array of the archers. "They entered on horseback into the way where the great hedges were on both sides set full of archers. As soon as the men-of-arms entered, the archers began to shoot on both sides, and did slay and hurt horses and knights; so that the horses, when they felt the sharp arrows, they would in no wise go forward, but drew back, and flung, and took on so fiercely, that many of them fell on their masters, so that for the press they could not rise again, insomuch that the Marshal's battle could never come at the Prince. Certain knights and squires, that were well horsed, passed through the archers, and thought to approach to the Prince, but they could not. . . . . So within a short space, the Marshal's battles were discomfited, for they fell one upon another, and could not go forth; and the Frenchmen that were behind, and could not get forward, recoiled back and came on the battle of the Duke of Normandy, the which was great and thick, and were afoot. But anon, they began to open behind; for when they knew that the Marshal's battle was discomfited, they took their horses and departed, he that might best; also they saw a rout of Englishmen coming down a little mountain a-horseback, and many archers with them, who broke in on the side of the Duke's battle.

"True to say, the archers did their company that day great advantage, for they shot so thick, that the Frenchmen wist not on what side to take heed; and, little and little, the Englishmen won ground on them; and when the men-of-arms of England saw that the Marshal's battle was discomforted, and that the Duke's battle began to disorder and open, they leaped then on their horses, the which they had ready by them. Then they assembled together, and cried, 'Saint George for Guienne;' and the Lord Chandos said to the Prince, 'Sir, take your horse and ride, for then this journey is your's. God is this day in your hands—get us to the French king's battle, for there lieth all the sore of the matter. I think verily by his valiantness he will not fly; I trust we shall have him, by the grace of God and Saint George, so he be well fought withal; and, Sir, I heard you say that this day I should see you a good knight.' The Prince said, 'Let us go forth; ye shall not see me this day return back;' and said, 'Advance, Banner, in the name of God and Saint George!' The knight that bare it did his commandment; there was then a sore battle and perilous, and many a man overthrown, and he that was once down could not be relieved again without great succour and aid. As the Prince rode and entered in among his enemies, he saw on his right hand, in a little bush, lying dead, the Lord Robert of Duras, and his banner by him. Then the Prince said to two of his squires, and to three archers, "Sirs, take the body of this knight on a targe and bare him to Poitiers, and present him from me to the Cardinal of Perigord, and say how I salute him by that token:' and this was done." This striking incident, which forms the subject of our engraving, needs a word of explanation, which we may here, with Froissart, pause a moment to give. "The Prince was informed that the Cardinal's men were on the field against him, the which was not pertaining to the right order of arms, for men of the church, that cometh and goeth for treaty of peace, ought not by reason to bear harness, nor to fight for neither of the parties." The Prince's embassy was therefore at once a most significant reproof and commentary. Another of the Cardinal's men, the Châtelain of Amposta, narrowly escaped a worse fate than the Lord Duras: being taken prisoner, the Prince ordered him to be beheaded; but the famous warrior Sir John Chandos succeeded in obtaining an arrest of the order.

Afghan Irrigation.—Immediately on crossing the river of Ghoorbund, we entered Kohistan Proper, a country rich without parallel. It is of no great extent, its form being that of the segment of a circle, the length of which is about sixteen or eighteen miles, and five or six its greatest depth. The fertility and productiveness of the soil is equalled by the industry of the people, who, forming bank above bank, acquire, as it were, land from their stony hills, all of which they irrigate with a care and zeal greatly to be admired. Aqueducts may be often seen fifty and sixty feet up the hill, conducted round every swell and valley, till at last they pour out their contents on the embanked fields. Irrigation from natural rivulets is of course more economical than by canals or subterraneous water-courses. The canals are either dug by the government or the villagers make common cause. If the former, the revenue derived is considerable; one hundred rupees per annum being charged for every place through which the supply passes. In some parts of the country the water, after being conducted, is made free property; in others it is carefully distributed and sold. A cut from a canal ten fingers broad and five deep is sufficient to irrigate eight khurwars of grain. Much abuse, however, attends the subdivision of the water, and the owners of lands at the lower extremity of a canal are often obliged to watch over the proceedings of those who live higher up, and even to bribe them not to damage their fields by stopping the supply. For one night's supply to a crop of twenty khurwars, from fifty to a hundred rupees are sometimes given.—*Sir Alexander Burnes' Cabool.*

No Inquiry without its Use.—It seems to be a necessary condition of human science, that we should learn many (apparently) useless things in order to become acquainted with those which are of service; and as it is impossible, antecedently to experience, to know the value of our acquisitions, the only way in which mankind can secure all the advantages of knowledge is to prosecute their inquiries in every possible direction. There can be no greater impediment to the progress of science than a perpetual and anxious reference at every step to palpable utility. Assured that the general result will be beneficial, it is not wise to be too solicitous as to the immediate value of every individual effort. Nor is it to be forgotten that trivial and apparently useless acquisitions are often the necessary preparatives to important discoveries. The labours of the antiquary, the verbal critic, the collator of mouldering manuscripts, the describer of microscopic objects (labours which may appear to many out of all proportion to the value of the result), may be preparing the way for the achievements of some splendid genius, who may combine their minute details into a magnificent system, or evolve from a multitude of particulars, collected with painful toil, some general principle destined to illuminate the career of future ages. To no one perhaps are the labours of his predecessors, even when they are apparently trifling or unsuccessful, of more service than to the metaphysician; and he who is well acquainted with the science can scarcely fail to perceive that many of its inquiries are gradually converging to important results. Unallied as they may appear to present utility, it is not hazarding much to assert that the world must hereafter be indebted to them for the extirpation of many mischievous errors, and the correction of a great part of those loose and ill-founded opinions by which society is now pervaded.—*Essays on the Formation and Publication of Opinions.*

[The Edible Chestnut (*Fagus Castanea*).—From a Specimen in Greenwich Park.]

THE CHESTNUT.

THE edible chestnut is not so common a tree as the horse-chestnut, with which it is often confounded, and both Gerard and Evelyn treated of the two in the same chapter. The former tree is more nearly allied to the beech, and was classed by Linnæus in the same order; but the flowers are differently formed, and the nut of the former is farinaceous, while the beech nut is oily. In the system of modern naturalists the sweet chestnut constitutes a distinct genus. The leaves are long, terminating in a point, with the edges indented, and of a rich shining green, and the flowers are of a greenish-yellow. The nut is surrounded by a husk strongly armed with prickles. The chestnut was brought from Sardis, in Asia Minor, and planted in Greece several centuries before the Christian æra. The Romans obtained it from the Greeks, and called its fruit the Sardis nut. With the extension of the Roman empire the chestnut was introduced into most parts of Europe. A controversy was carried on during the last century, as to whether the edible chestnut was indigenous in England, but it appears to have been determined in the negative. It is most abundant in the south of France, in Switzerland, and particularly in Spain and Italy, and is generally found on slopes where the corn-lands terminate. The wild chestnuts on Mount Ætna are some of them of stupendous size, and one measured by Brydone was found to be two hundred and four feet in girth. It appeared as if the trunks of five distinct trees had grown together, but on closer examination there seemed reason to believe that they were once united. This tree bears the name of *Castagno del cento cavallo*, on account, as they say, of its being capable of sheltering a hundred horsemen. The natural region of the chestnut is co-extensive with that of the vine, beyond which limits its fruit does not always arrive at perfection. It is not found in Denmark, Sweden, or Norway. In Ireland the fruit does not ripen at all, and but seldom in Scotland. The quantity of English-grown chestnuts for sale is comparatively small, the chief supply being obtained from Spain, from which we import about thirty thousand bushels annually, paying a duty of two shillings per bushel. The trees which produce the best fruit are varieties improved by cultivation and by grafting, and the quality accordingly differs as widely as the crab from the apple.

When Evelyn published his 'Sylva,' in 1664, the potato was scarcely known as an article of food, and he strongly recommended the cultivation of the chestnut for the sake of its fruit, which, he says, is "a lusty and masculine food for rustics at all times, and of better nourishment for husbandmen than cole (cabbage) and rusty bacon, yea, or beans to boot;" but, he observes, "we give that fruit to our swine in England which is amongst the delicacies of princes in foreign countries." He then describes the different foreign modes of preparing chestnuts for the table:—"They boil them in Italy with their bacon; and in Virgil's time they eat them with milk and cheese. The best tables in France and Italy make them a service, eating them with salt, in wine, or juice of lemon and sugar, being first roasted in embers on the chaplet; and doubtless we might propagate their use among our common people, being a food so cheap and lasting.

In Italy they boil them in wine, and then smoke them a little; those of Piedmont add fennel, cinnamon, and nutmeg to their wine; but first they peel them. Others macerate them in rose-water. The bread of the flour is exceedingly nutritive." Gerard, in his 'Herbal,' published in 1597, says:—"Some affirm that of raw chestnuts dried, and afterwards turned into meal, there is made a kind of bread, yet it must needs be that this should be dry and brittle, and hardly concocted;" and he correctly states that it is not very digestible. Mr. Loudon, in his 'Arboretum,' has given an account of the present modes of preparing the chestnut for food in the south of Europe. Besides the ordinary method of roasting, the flour is made into cakes, and into a thick porridge and soup. The former, called *la galette*, "is a species of thick flat cake, which is made without yest, and baked on a kind of girdle or iron plate, or on a hot flat stone. It is generally mixed with milk and a little salt, and is sometimes made richer by the addition of eggs and butter; and sometimes, when baked, it is covered with a rich custard before serving." The porridge termed *la polenta* is made exactly in the same manner as oatmeal porridge, either with milk or water. A mess resembling mashed potatoes is also made by boiling the chestnuts whole in water with a little salt, until they become soft. These are the common modes of preparing the chestnut where it constitutes, as in parts of Spain, Italy, and the south of France, the ordinary food of the peasantry, serving as a substitute for bread and the potato. The confectioners on the Continent make a sweetmeat of the fruit by first cooking and then dipping the nuts in clarified sugar. In Paris the street venders of roasted chestnuts are as numerous as the sellers of hot baked potatoes in London.

In Evelyn's time, and long afterwards, it was generally believed that the timber found in some of our most ancient buildings was the wood of the chestnut: in consequence of this belief it was extensively planted, and the Society of Arts encouraged its cultivation by gifts of medals. It is now well ascertained that the chestnut is of little value for timber, and, unlike other trees, it is more durable before it has reached maturity than at any subsequent period. The small quantity of sapwood in young trees renders it very useful as coppice-wood. It is true that the chestnut bears some resemblance to oak timber, and this occasioned the ancient oak carpentry of old edifices to be mistaken for chestnut. Mr. Loudon states that the latter may be distinguished from oak "by the transverse fibres being more confused and much less evident to the naked eye." It is used for making tables, stools, chairs, chests, bedsteads, tubs, and vessels for holding liquids, for which latter purpose it is said to be superior to other trees, on account of its neither shrinking nor swelling. The same quality renders it well adapted for water-pipes. Posts for gates and fences made from the wood of trees which had not reached maturity have lasted longer than the oak. The chestnut is also extensively used for hop-poles.

In England the chestnut is grown for ornament rather than use. It flourishes in a deep light loam, in a sheltered situation, and in about half a century attains a height of sixty or eighty feet; but after it has come to maturity, its existence is said to be prolonged for several centuries, though it ceases to be valuable for timber. One of the finest trees in England is at Studley Park, near Ripon: it is one hundred and twelve feet high; at one foot from the ground the trunk is seven feet four and a half inches in diameter, and the diameter of the head is ninety-one feet six inches; but trees of the average size have a stately and noble appearance, something between the oak and the ash. The foliage hangs in a loose, graceful, and ornamental style, and in autumn glows with the brightest hues of that rich pictorial season. The odour of the flowers is not considered pleasant by some persons, on which account the chestnut should not be planted close to the house. Salvator Rosa has introduced the chestnut into many of the wild-looking scenes which he loved to depict.

[Leaves and Blossom of the Edible Chestnut.]

ON THE EFFECT OF OIL IN STILLING WAVES.

Among the statements made by Pliny, in his 'Natural History,' eighteen centuries ago, was one which has obtained but little credit until modern times, although now no longer doubted. It relates to the effect of a thin stratum of oil in stilling waves. Pliny mentions this property as having been known to the divers of his time; they poured a little oil on the surface of the water, in order that, by stilling its ripplings, the rays of light might be better able to penetrate to the bottom. About seventy years ago the subject was much discussed by several Fellows of the Royal Society, including Dr. Franklin; and subsequent inquiries have shown that the property in question is familiarly known to maritime men in different countries. We will first enumerate a few facts collected from various quarters; and then describe some experiments which Franklin made on the subject.

Sir Gilfred Lawson, who served in the British army at the defence of Gibraltar, told Dr. Brownrigg that the fishermen of Gibraltar were accustomed to pour a little oil on the sea, in order to still its motion, that they might be enabled to see the oysters lying at its bottom: Sir Gilfred had often seen this done. Dr. Franklin was informed that many of the divers on the coast of Italy were accustomed to take a little oil in their mouths before they dived; when they had descended to a certain depth, they allowed the escape of the oil, which, rising to the surface by virtue of its lightness, spread in a thin film, which smoothed the

water-ripples, and allowed light to descend to a considerable depth. The fishermen of Lisbon, when about to return into the river, if they saw before them too great a surf upon the bar, were accustomed to empty a bottle or two of oil into the sea, to still the breakers. Sir John Pringle was informed that the persons employed in the herring fishery off the coast of Scotland could see at a distance where the shoals of herrings were, by the smoothness of the water over them, occasioned, as he supposed, by some kind of oiliness proceeding from the bodies of the fish. It has been observed by the seal-catchers on the coast of Scotland, that when these animals are devouring a very oily fish, which they do under water, the waves above become remarkably smooth.

A passenger to the Eastern ocean in a Dutch ship, in the year 1770, wrote a letter to a Count Bentinck, in which the following statement was given:—"Near the islands Paul and Amsterdam we met with a storm, which had nothing particular in it worthy of being communicated to you, except that the captain found himself obliged, for greater safety in wearing the ship, to pour oil into the sea, to prevent the waves breaking over her; which had an excellent effect, and succeeded in preserving us. As he poured out but a little at a time, the East India Company owes perhaps its ship to only six demi-aumes of olive oil. I was present upon deck when this was done; and I should not have mentioned this circumstance to you, but that we have found people here so prejudiced against the experiment, as to make it necessary for the officers on board, and myself, to give a certificate of the truth on this head; of which we made no difficulty."

The incident which first drew Franklin's attention to this subject he thus narrates:—"In 1757, being at sea in a fleet of ninety-six sail bound against Louisbourg, I observed the wakes of two of the ships to be remarkably smooth, while all the others were ruffled by the wind, which blew fresh. Being puzzled with the differing appearance, I at last pointed it out to our captain, and asked him the meaning of it. 'The cooks,' said he, 'have, I suppose, been just emptying their greasy water through the scuppers, which has greased the sides of those ships a little!' and this answer he gave me with an air of some little contempt, as to a person ignorant of what everybody else knew. In my own mind I at first slighted his solution, though I was not able to think of another."

Franklin, however, was not a man to let such an inquiry drop till he had arrived at some satisfactory conclusion. He conversed with maritime persons on the matter, and found that the effect of oil in stilling waves was known to many of them. He resolved, therefore, to make experiments for himself, and selected a pond on Clapham Common as the locality. He dropped a little oil in the water, and says, "I saw it spread itself with surprising swiftness upon the surface, but the effect of smoothing the waves was not produced; for I had applied it first upon the leeward side of the pond, where the waves were largest, and the wind drove my oil back upon the shore. I then went to the windward side, where they began to form; and there the oil, though not more than a tea-spoonful, produced an instant calm over a space several yards square, which spread amazingly, and extended itself gradually till it reached the lee-side, making all that quarter of the pond, perhaps half an acre, as smooth as a looking-glass." He describes the film of oil as being reduced to such extreme thinness as it spread, as to give out the prismatic colours, and afterwards to be quite invisible except in relation to the stilling effect which it produced.

After this experiment, Franklin adopted an expedient quite characteristic of his untiring love of inquiry into natural phenomena: he contrived to hollow out the upper joint of his bamboo walking-stick, and put a little oil in it whenever he was going into the country; he was thus enabled to repeat the experiment many times, and always produced similar results. During a visit which he afterwards paid to the celebrated Smeaton, Franklin was told by a Mr. Jessop, a pupil of Smeaton's, that having thrown into some water a few flies which had been drowned in a cup containing oil, he was surprised to see the flies presently begin to move and rotate rapidly on the water, as if they were alive, though on examination he found them to be quite dead. Franklin had before observed that the oil on the surface of water seems to be endowed with a kind of repulsive action among its particles, which acted also on any light substances, such as straws, leaves, or chips floating on the surface; and he conceived that the flies rotated in consequence of a repulsion exerted as the oil oozed from their bodies. He showed that organised structure had nothing to do with the matter, for he produced similar movements by placing on the surface of water small oiled chips cut into the form of a comma (,); as the oil issued from the point of the comma, the chips began to rotate.

The explanation which Franklin offered of the sedative effect of the oil upon waves is very ingenious. Air, when in motion, in the shape of wind, over the surface of smooth water, probably *rubs*, as it were, on that surface, and raises it into wrinkles, which, if the wind continues, are the elements of future waves. The smallest wave, once raised, does not immediately subside and leave the neighbouring water quiet; but in subsiding raises nearly as much of the water next to it, in the same way as a stone dropped into water raises a series of concentric waves around it. As a small power continually in operation will produce a great effect, so the small first-raised waves, being continually acted on by the wind, are, though the wind does not increase in strength, continually increased in magnitude, rising higher and extending their basis, so as to include a vast mass of water in each wave, which in its motion acts with great violence. This being the mode in which ordinary waves are formed, Franklin conceived that when oil is poured on the surface of water, and retained there by its smaller specific gravity, there is a repulsive power which drives the particles of oil one from another, extending them into a film of the greatest possible tenuity. "Now," says he, "I imagine that the wind blowing over water thus covered with a film of oil cannot easily *catch* upon it, so as to raise the first wrinkles, but slides over it, and leaves it smooth as it finds it. It moves a little the oil, indeed, which, being between it and the water, serves it to slide with, and prevents friction, as oil does between those parts of a machine that would otherwise rub hard together. Hence the oil dropped on the *windward* side of a pond proceeds gradually to leeward, as may be seen by the smoothness it carries with it, quite to the opposite side; for the wind being thus prevented from raising the first wrinkles, that I call the elements of waves, cannot produce waves, and thus the whole pond is calmed."*

Franklin's practical turn of mind led him to conjecture whether this principle might not be applied where voyagers, desirous of landing at any particular shore, are prevented from so doing by a violent surf which breaks on the shore. His idea was that by sailing to and fro at some distance from a lee-shore, continually pouring oil into the sea, the waves might be so much depressed and lessened before they reached shore, as to abate the height and violence of the surf, and permit a landing. Assisted by Sir Joseph Banks, Dr. Blagden, and Dr. Solander, Franklin made an

* 'Phil. Trans.,' vol. lxiv.

experiment on this point at the entrance of Portsmouth Harbour, nearly opposite Haslar Hospital. A party left a ship, in the long-boat, and took up a position a quarter of a mile from the shore, with a wind blowing towards shore; another party were in the barge at double that distance from the shore; while a third party watched the effects from the shore itself. The experimenters in the barge made trips too and fro, of about half a mile each, parallel with the shore; pouring oil continually out of a large stone bottle, through a hole in the cork somewhat larger than a goose-quill. It was found that the height and motion of the waves were not materially lessened; but the persons in the long-boat could observe a tract of smoothed water, extending the whole length of the distance in which the oil was poured, and gradually spreading in breadth from the track of the barge towards the long-boat. This portion of sea was not levelled, but it was free from the small wrinkles usually observed on the waves themselves, and also totally free from the foam exhibited in similar situations. The men in a sailing-boat, which happened to be passing that way, purposely chose that tract which had been smoothed by the oil, as being more calm and easy of navigation. Although, therefore, the oil had not the effect of destroying the waves themselves, it reduced them to calm and gently swelling undulations. When the wind blows fresh, there are continually rising on the back of every great wave a number of small waves, which roughen its surface, and give the wind a kind of hold or purchase to push it with greater force. It seems pretty evident that oil, although it cannot stop powerful waves already formed, which acquire a power of oscillation totally independent of the continuance of the wind, will prevent the formation of the subordinate waves which increase the bulk and force of the former.

We are not aware whether any recent attempts have been made to apply this curious principle to any useful purpose.

ROADS AND ROAD-MAKING IN THE UNITED STATES.

[From a Correspondent.]

It is hardly to be expected in a country so *new*, comparatively, as the United States, where considerably the larger portion of the present inhabited territory was an uninterrupted forest or wilderness half a century ago, that the generality of the roads should be as good and complete as the roads of older, wealthier, and more densely populated countries.

The earliest made, and consequently the oldest class of roads in the United States, are the *state roads;* so called from their being originally made at the cost of the respective states through which they pass. A road of this description will often be found passing through vast tracts of country wholly uninhabited, and until a portion of the adjacent country becomes settled, there are comparatively but few travellers passing along such lonely routes, so that the roads are very little injured by the traffic upon them. Indeed they are rather looked upon as mere outlets from one part of an extensive territory to another, and therefore are only presumed to be frequented by persons whose business imperatively calls them to a distance from the reclaimed portions of the country. It frequently happens that one of these roads will intersect the entire length or breadth of a state; nor will it probably be allowed to terminate at the extreme boundary thereof, for the adjoining state or territory may be induced to continue the line as far as its limits permit, and a third and a fourth state may by chance continue the same route.

The plan adopted in making these roads is not calculated to induce the traveller to frequent them, if there is not an absolute necessity for his doing so; for besides grubbing up a few of the largest trees which happen to grow along the line, and cutting down the smaller trees and brushwood, little more is done than opening an irregular ditch on either side, and filling up the holes or inequalities of the surface with the soil taken therefrom; the width (which is rarely more than twelve or fourteen feet) varying according to the obstacles which may happen to present themselves on either hand. Where small creeks or streams are fallen in with, rude wooden bridges are constructed across them; but when a stream or river of considerable size interferes with the route, no attempt is made at throwing a bridge across it, the state authorities preferring to leave it to the ingenuity of the traveller to find out some plan of reaching the opposite side.

Since this class of roads has little care or attention paid at the time of construction, even where one of them is the least frequented, it is liable, in the course of a few years, through the action of the frost during winter, and the washing of heavy rains at other seasons, to get so much out of order as to render it nearly impassable; while the conduits and bridges, being constructed of perishable timber, ten or a dozen years is an abundantly sufficient period for most of them getting completely out of repair. And since it rarely happens that the state authorities ever look after them when once they have been constructed, and as no tolls are collected, nor taxes levied to keep them in repair, it must be obvious that, in the lapse of years, they will possess few of the attributes of a *road*, save the original name.

However, as the lands in the localities through which such roads pass become taken up, or settled upon, it is by no means unusual for these roads, or sections of them, to be taken possession of by the inhabitants, repaired, and converted into *township roads*—a class of roads made and maintained by the respective townships through which they pass, and for the making or improving of which the inhabitants of each township voluntarily tax themselves. But since cash in most new countries or settlements is a scarce article, the road-taxes are usually paid in a specified amount of labour performed annually upon one or other of the roads intersecting the township in which an occupier's farm is situated, who is moreover commonly allowed to work out his tax upon the particular line of road with which his lands are most immediately connected. These roads are, however, for the most part, but mere passable tracts; especially in the newer sections of the states, being made at a small expense, the condition of the settlers not allowing of much outlay upon roads, either in the form of money or labour.

Considering the great extent of country, there are comparatively few *turnpike-roads* in any part of the United States, and only one of any considerable extent, belonging to the nation at large. The road here alluded to is the line of turnpike commencing at the City of Washington, and from thence running westward through a portion of Virginia, thence across the Ohio river, and so traversing the several intervening states lying between that river and the Mississippi. It is called the Great Western, or National Turnpike Road, and is undoubtedly the greatest undertaking of the sort in America. But the various states, individually, have entered more or less into the spirit of road-making, and as these roads (except the state roads already spoken of) come under the denomination of turnpikes, a separate notice becomes necessary.

Turnpike-roads—that is, such roads as toll-bars or toll-gates are established upon, at which tolls are collected—are never made in the United States, except

under an express act or charter from the legislature of the respective state to which these roads belong. During the last quarter of a century or more, in most parts of the Union, the people have been unceasingly clamorous for what is commonly designated "internal improvements." These comprehend the construction of canals and the improvement of the channels of creeks and rivers, as well as the making of turnpike and rail roads. Some of these undertakings are performed exclusively at the expense of the state, while others—and particularly the roads—have been commonly undertaken by companies who subscribe a portion of the stock, the state government holding the remaining shares, or in some cases making considerable grants of the public money in order to induce individuals and companies to enter into such hazardous undertakings. In this way most of these public works have been brought into the state which they are found at present; and notwithstanding many of them present great advantages to the sections of country through which they pass, by presenting facilities for conveying the produce of the country to market, receiving merchandise in return, and for travelling, yet at the same time they become such heavy burdens to the states which have supplied the funds for the completion of the works, as to threaten several of them with ruin, or at least a condition closely bordering upon bankruptcy.

It is not a little surprising that through many of the older and more populous districts, and on routes connecting some of the principal cities, the roads are still in a very poor condition, few of them being anything more than township roads; and where turnpike trusts exist, they are but little better, since few of these are macadamised, or made after the manner we find them in England. Indeed, when it is stated that on few of the lines of turnpike-roads which have been made, even in portions of the country where the ground is rough and hilly, has the cost of making exceeded ten or twelve hundred dollars per mile (from 200*l.* to 240*l.* sterling), and this too where wages are very high, it will be readily perceived that they cannot be very perfect or finished performances. The mode of making them is this:—where the ground is free from trees and stumps, the whole of the site of the intended road is ploughed up lengthwise, or in the direction it runs, and afterwards harrowed and the large stones picked out. The soil towards the extreme sides is then moved towards the centre, by employing an implement called a scraper, and then the sides and ditches are again ploughed with a powerful team of oxen, and the soil and subsoil thus loosened is again scraped towards the centre or crown of the road. After the arched mound of earth has been raised sufficiently in this way, and the whole has been rendered tolerably smooth by means of hand-hoes, the work is considered finished. But in the forests the trees have first to be grubbed up, and the immense roots rolled out of the way on either side; when the soil is afterwards loosened by ploughing, as has already been stated. But a stronger plough and a more powerful team are necessary under such circumstances than where there were neither trees nor stumps, for even after the trees have been grubbed up, the entire space is intersected with roots of various sizes, which are serious obstacles in the way of a plough, and often require a team of six, eight, or ten oxen to perform the task. In many situations the ground is so marshy and wet, that the soft nature of it will not admit of any traffic passing over it, and instead of using better and more durable materials, the forest-trees are cut into proper lengths, and then, without any hewing, squaring, or even barking, laid side by side—crosswise on the line of road—and thus form what is called the *corduroy* plan of road-making. Sometimes a little soil is brought from wherever it can be had, to fill up the hollows between the arches of the logs, but this is commonly soon worn or washed away, when the logs present a wearisome succession of narrow ridges to the unfortunate traveller. The traveller is indeed unfortunate who has to journey over several miles of "corduroy turnpike," since it is with difficulty that the nimble-footed horses bred in the new settlements manage to perambulate several miles of this description of road without many a false step and stumble; while it is still worse where any sort of vehicle with wheels is employed, since the continual severe jolting is almost sufficient to dislocate the bones, unless they be more firmly united than is ordinarily the case.

Very few of these turnpike-roads are enabled, by the tolls collected upon them, to be kept in tolerable repair; and still fewer yield any dividends to the state or other stock-holders. Indeed it is nothing uncommon to meet with roads of this description that have been so injudiciously laid out, or so wretchedly constructed, that in a few years after their first being opened they have become so thoroughly out of repair, that the toll-gates have been taken away and the roads thrown open, so that every farthing of money expended upon them has been sacrificed by those who were at the expense of making them.

The principle upon which the collecting of tolls is founded, as regards the turnpike-roads in the United State, is different from, and certainly more equitable than, the plan which generally obtains in this country. There the charge is so much per mile for the distance travelled; while here a specified sum is claimed for passing through the toll-bar, no matter whether the traveller has used one mile or twenty miles of the road upon which the toll-bar is erected. For instance, a farmer or any other person residing four miles on one side of the turnpike-gate, will, in all probability, on reaching the place of collection, be recognised by the collector, and his demand, without any further inquiry, would be neither more nor less than the small fractional sum, whatever it might be, that the toll upon the four miles of road came to. But if a stranger presented himself, he would be asked how far he had travelled by that line of road, and if he could make it satisfactorily apparent that he had used it only from some point within a mile or two of the toll-bar, the small sum covering that short distance would be all which he would be required to pay. If, on the contrary, it appeared that the stranger traveller had used the whole extent of road for which the collector could lawfully demand toll, the full amount would then be insisted upon. It is true that toll-collectors are to some extent liable to imposition under such a regulation, but on the whole it is devoid of the severe compulsion attendant upon our own system of taking the full amount of toll where parties travel very short distances upon such lines of road; nor does the custom obtain of allowing the same parties to travel through the gate a dozen times or more in the same day for once paying toll, as is the plan with most of the turnpike trusts in England.

During three or four months, or while hard frosts continue and snow remains upon the ground, so that sleighs or sledges are in general use in the place of wheel-carriages, many of the turnpike tolls in the Northern and Eastern states produce but very little on which, at other seasons of the year, a tolerable amount is usually collected. This is in consequence of the frost and a thick covering of snow hiding all imperfections in the township and bye roads, so that most persons—at least such as are familiar with the localities through which such roads pass—prefer driving a mile or two out of their way in order to avoid the payment of a few cents.